WHAT IS CLAIMED IS:

1. An apparatus for estimating a road condition for use in a vehicle having steering control means for actuating a device mechanically independent of a manually operated steering member to steer at least a wheel of front and rear wheels of said vehicle, comprising:

actuating signal detection means for detecting an actuating signal for actuating said device of said steering control means;

aligning torque estimation means for estimating an aligning torque produced on said wheel on the basis of the actuating signal detected by said actuating signal detection means;

vehicle state variable detection means for detecting a state variable of said vehicle;

wheel factor estimation means for estimating at least one of wheel factors including a side force and a slip angle applied to said wheel on the basis of the state variable detected by said vehicle state variable detection means; and

grip factor estimation means for estimating a grip factor of at least a tire of said wheel, in accordance with a relationship between the aligning torque estimated by said aligning torque estimation means and the wheel factor estimated by said wheel factor estimation means.

2. An apparatus for estimating a road condition as set forth in claim 1, further comprising;

reference aligning torque setting means for setting a reference aligning torque on the basis of the wheel factor estimated by said wheel factor estimation means and the aligning torque estimated by said aligning torque estimation means,

wherein said grip factor estimation means estimates the grip factor of said tire on the basis of a result of comparison between the aligning torque estimated by said aligning torque estimation means and the reference aligning torque set by said reference aligning torque setting means.

3. An apparatus for estimating a road condition as set forth in claim 2, wherein said reference aligning torque setting means sets the reference aligning torque by approximating a characteristic of the aligning torque estimated by said aligning torque estimation means against the wheel factor estimated by said wheel factor estimation means to a linear characteristic of the reference aligning torque including at least the origin, and sets the reference aligning torque on the basis of the linear characteristic of the reference aligning torque.

4. An apparatus for estimating a road condition as set forth in claim 2, wherein said reference aligning torque setting means sets a linear characteristic of the reference aligning torque with a gradient which is provided by a brush model of said wheel, and sets the reference aligning torque on the basis of the linear characteristic of the reference aligning torque.

5. An apparatus for estimating a road condition as set forth in claim 1, further comprising;

friction estimation means for estimating a coefficient of friction of a road on which said vehicle is running, on the basis of the grip factor estimated by said grip factor estimation means.

6. An apparatus for estimating a road condition as set forth in claim 5, further comprising;

warning means for warning to a vehicle driver when at least one of road factors including the grip factor estimated by said grip factor estimation means and the coefficient of friction estimated by said friction estimation means is less than a predetermined value.

7. A vehicle motion control apparatus having an apparatus for estimating a road condition for use in a vehicle having steering control means for actuating a device mechanically independent of a manually operated steering member to steer at least a wheel of front and rear wheels of said vehicle, comprising:

actuating signal detection means for detecting an actuating signal for actuating said device of said steering control means;

aligning torque estimation means for estimating an aligning torque produced on said wheel on the basis of the actuating signal detected by said actuating signal detection means;

vehicle state variable detection means for

detecting a state variable of said vehicle;

wheel factor estimation means for estimating at least one of wheel factors including a side force and a slip angle applied to said wheel on the basis of the state variable detected by said vehicle state variable detection means;

grip factor estimation means for estimating a grip factor of at least a tire of said wheel, in accordance with a relationship between the alignment torque estimated by said aligning torque estimation means and the wheel factor estimated by said wheel factor estimation means; and

control means for performing at least one of a steering control to front wheels of said vehicle, a steering control to rear wheels of said vehicle and a braking force control to each wheel of said vehicle, on the basis of the grip factor estimated by said grip factor estimation means.

8. A vehicle motion control apparatus as set forth in claim 7, further comprising;

friction estimation means for estimating a coefficient of friction of a road on which said vehicle is running, on the basis of the grip factor estimated by said grip factor estimation means,

wherein said control means performs at least one of the steering control to front wheels of said vehicle, the steering control to rear wheels of said vehicle and the braking force control to each wheel of said vehicle, on the basis of at least one of road factors including the grip

factor estimated by said grip factor estimation means and the coefficient of friction estimated by said friction estimation means.

9. A vehicle motion control apparatus as set forth in claim 8, wherein said control means provides parameters for at least one of the steering control to front wheels of said vehicle, the steering control to rear wheels of said vehicle and the braking force control to each wheel of said vehicle, on the basis of at least one of the road factors including the grip factor and the coefficient of friction.

10. A vehicle motion control apparatus as set forth in claim 8, wherein said control means performs a reaction force control to said manually operated steering member, and wherein said control means provides a parameter for said reaction force control, on the basis of at least one of the road factors including the grip factor and the coefficient of friction.

11. A vehicle motion control apparatus as set forth in claim 8, wherein said control means provides a characteristic of steering amount of wheel in accordance with the amount of steering operation of a vehicle driver for the steering controls to front wheels and rear wheels of said vehicle, on the basis of at least one of the road factors including the grip factor and the coefficient of friction, and wherein said control means provides a characteristic of a desired braking force in accordance with the amount of braking operation of the vehicle driver for

the braking force control to each wheel of said vehicle, on the basis of at least one of the road factors including the grip factor and the coefficient of friction.

12. A vehicle motion control apparatus as set forth in claim 7, further comprising;

reference aligning torque setting means for setting a reference aligning torque on the basis of the wheel factor estimated by said wheel factor estimation means and the aligning torque estimated by said aligning torque estimation means,

wherein said grip factor estimation means estimates the grip factor of said tire on the basis of a result of comparison between the aligning torque estimated by said aligning torque estimation means and the reference aligning torque set by said reference aligning torque setting means.

13. A vehicle motion control apparatus as set forth in claim 12, wherein said reference aligning torque setting means sets the reference aligning torque by approximating a characteristic of the aligning torque estimated by said aligning torque estimation means against the wheel factor estimated by said wheel factor estimation means to a linear characteristic of the reference aligning torque including at least the origin, and sets the reference aligning torque on the basis of the linear characteristic of the reference aligning torque.